REMARKS

Claims 1-12, 15-34, 39-47, and 50-58 are pending. By this Amendment, claims 1-3, 5, and 15 are amended, and claims 35-38 and 48-49 are canceled.

The Office action rejects claims 1-12, 15-34, 39-47, and 50-58 under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over by Hijiya et al. (US Pat. 5,101,249).

Applicants respectfully submit that the cited reference is no more relevant than the prior art cited in the previous Office action (US Pat. 5,619,052 to Chang et al.). Both of the cited references concern improvements to conventional floating gate non-volatile memory devices in which charge tunnels from the source-drain path onto the floating gate of a transistor through an insulating layer or vice versa. This is completely different to the claimed invention in which the charge tunnels onto the floating gate from an electrode above the floating gate, through a barrier structure that gives rise to a significantly improved memory performance.

Referring to FIG. 1 of Hijiya, current flowing in a channel 5 between source and drain regions 3,4 is controlled depending on the level of stored charge held on floating gate 7. In a conventional manner, the source-drain path is controlled by gate 11-2 which contacts a conductive polysilicon layer 9 and is capacitively coupled to the floating gate 7 through a dielectric layer 8 that comprises insulating silicon dioxide. Charge is either stored on or discharged from the floating gate 7 by applying appropriate control voltages to the device, causing electrons to tunnel through an insulating tunnel barrier layer 6 beneath gate 7. There is no electron transfer between the gate electrode 11-2 and the floating gate 7 through the insulating layer 8.

As previously explained to the Examiner, the present invention works in a completely different way. In accordance with the invention, current flows from an overlying control gate to the floating gate or memory node when it is desired to charge or discharge the memory node. For example, referring to FIG. 1 of the present application, the memory node 1 overlies a source-drain path (S-Y) and is separated by a barrier structure 2 from an overlying electrode structure (X) which acts as a control gate. As explained in detail in the present application, the height of the electrostatic barrier provided by the barrier structure 2 is lowerable to enable the current to flow between the memory node 1 and the control electrode (X). Thus, in accordance with the

invention, the memory node 1 is either charged or discharged by currents flowing between the electrode structure (X) and the memory node. In the first configuration, the barrier structure 2 provides a relatively high barrier and hence charge is stored on the memory node. However, when the barrier structure is subject to an applied voltage, the barrier height is reduced enabling charge either to become stored on the memory node 1 or discharged from it. In either case, the current flow is to the control electrode (X) and not from the underlying channel of the device in the manner described in Hijiya.

Thus, our task is to embody this difference into the wording of the claims. The Examiner has objected that the device defined in our independent claims lacks novelty or is obvious in view of Hijiya because the only differences are the intended use of the device rather than a structural difference.

I disagree with this objection. Nevertheless, some changes are proposed to the independent claims in order to clarify the configuration of the floating gate, the barrier structure and the electrode structure. For example, claim 1 now recites the substrate and an insulating layer overlying the substrate, which is separate from the barrier layer through which charge carriers tunnel from the electrode structure. Thus, in Hijiya, charge tunnels to and from the floating gate 7 through the underlying insulating layer 6, whereas in the present invention, charge tunnels through an overlying barrier structure (lamination structure of claim 1).

It is submitted that the definition of the energy band profile of the lamination structure in claim 1 is not solely in terms of its intended use but in fact embodies a clear structural difference not found in Hijiya.

The arrangement of layers 8, 9 in Hijiya do not give rise to an energy band profile as defined in claim 1. More particularly, the energy band profile of layers 8, 9 is not "changeable between a first configuration in which the barrier height ... is high and a second configuration in which the barrier height ... is low." Instead, in Hijiya, the polycrystalline layer 9 is conductive and offers no significant barrier whereas the insulating layer 8 always presents substantially the same barrier height. As evidence from Hijiya, the barrier presented by the insulating layer 8 (which is relatively thick) prevents any significant charge transfer between the polycrystalline silicon layer 9 and the floating electrode 7. The barrier presented by layer 8 thus cannot be lowered to allow change transfer through it. Of course if 1000V is applied to the gate of Hijiya, the insulating layer 9 might break down and allow conduction, but the device would also be

destroyed. It is submitted therefore that a person skilled in the art would not reasonably consider the barrier presented by layer 9 to be one which can be raised and lowered to allow charge transfer to the charge storing node.

It should be noted that the band diagrams in FIGS. 2A, B and C of Hijiya do not relate to the band structure of layers 8, 9 but instead to the layer 6 that underlies the floating gate 7.

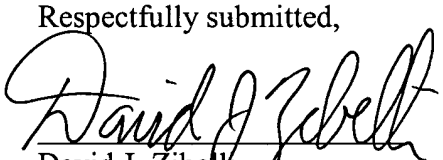
The Examiner is correct in noting that the final part of the claims characterizes in operational terms how charge transfers between the charge storing node and the electrode structure through the lamination structure but it is submitted that this does structurally limit the claimed device. The Examiner refers to ex parte Masham but the facts in that case were fundamentally different and related to the combination of material being worked with the inventive apparatus. The facts in the present application are significantly different.

For at least the above reasons, it is submitted that the application is in condition for allowance. Withdrawal of the objection is requested.

The Office is hereby authorized to charge any additional fees under 37 C.F.R. §1.16 or §1.17 or credit any overpayment to Deposit Account No. 11-0600.

Should the Examiner have any questions concerning this matter, he is invited to contact Applicants' undersigned attorney at 202/220-4334.

Respectfully submitted,



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